

Integrated MLI: Advanced Thermal Insulation Using Micro-Molding Technology, Phase II

Completed Technology Project (2007 - 2009)



Project Introduction

Lightweight, high performance thermal insulation is critical to NASA's next generation Exploration spacecraft. Zero or low cryogenic propellant boiloff is required during extended missions and lengthy on-orbit times. Multilayer insulation (MLI) is currently the insulation of choice for cryotank insulation. MLI's high vacuum performance exceeds alternative insulations by a factor of ten. However, heat flow through MLI is usually the largest heat leak in cryogenic systems, so improvements in thermal performance are desirable. Integrated Multi-Layer Insulation (IMLI) is an innovative new technology using a micro-molded polymer substructure integrated with radiation barriers to provide an ultra-high performance thermal insulation system. IMLI was proven a viable concept in Phase I work, reaching TRL4 with component validation in the laboratory. Prototypes were built and tested, demonstrating equal to lower thermal conductivity than MLI, and layers attached to each other in a snap-together assembly with controlled layer spacing. The Phase I IMLI prototype had a thermal conductivity of 1.8 W/m², with the Celcon polymer used for these prototypes still outgassing. The IMLI thermal conductivity was calculated to be 63% that of MLI, which would provide improved long term cryogenic propellant storage. This improved insulation can provide lower thermal conductivity, vacuum compatibility, layers inherently attached to each other that support themselves, and efficient assembly. IMLI may also provide inherent structural benefits, including improved strength and integrity over current MLI. This proposal is to further develop IMLI toward commercialization. Tasks proposed include a next generation design improving on what was learned in Phase I, for material selection, fabrication methods for seams and corners including interleaving and layer thermal matching, and building and testing prototypes in realistic environments such as a 500 liter cryotank.



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Glenn Research Center (GRC)

Responsible Program:

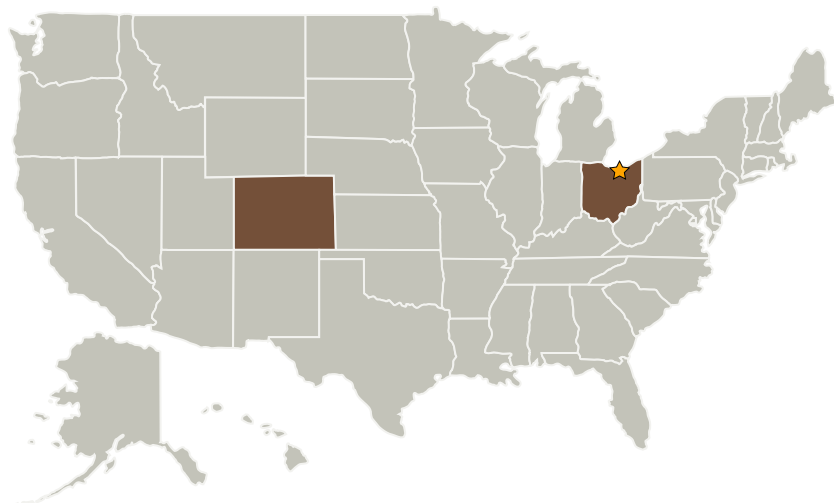
Small Business Innovation Research/Small Business Tech Transfer

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Primary U.S. Work Locations and Key Partners



Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX14 Thermal Management Systems
 - └ TX14.1 Cryogenic Systems
 - └ TX14.1.2 Launch Vehicle Propellant

Organizations Performing Work	Role	Type	Location
★ Glenn Research Center(GRC)	Lead Organization	NASA Center	Cleveland, Ohio
Quest Product Development Corporation	Supporting Organization	Industry	Arvada, Colorado

Primary U.S. Work Locations

Colorado	Ohio
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Project Transitions

**November 2007:** Project Start**November 2009:** Closed out